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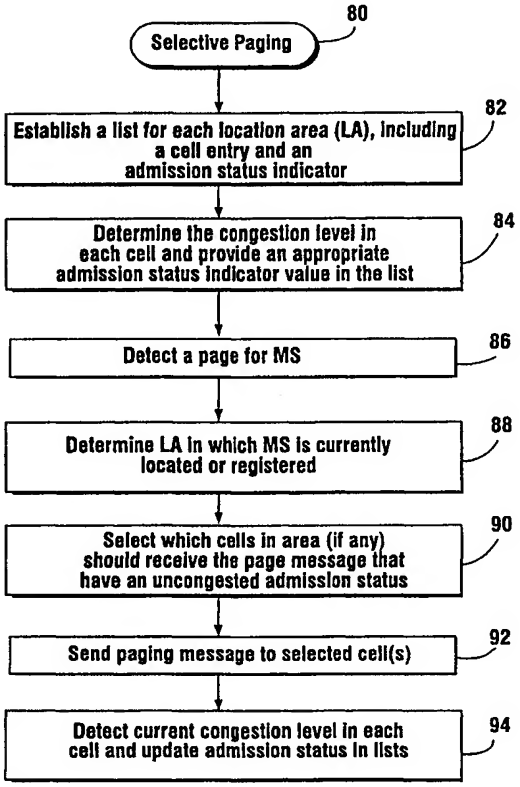
(54) Title: SELECTIVE AND EFFICIENT MESSAGING IN A MOBILE COMMUNICATIONS SYSTEM

(57) Abstract

A selective messaging procedure efficiently distributes messages only to eligible cells and eliminates distribution of unnecessary messaging information to ineligible cells in a mobile communications network. When information is received in the network that is intended for a mobile station located in an area containing one or more cells, the admission status associated with each of the cells in that area is determined. A message is then sent to one or more of the plural cells whose associated admission status is determined to be favorable. On the other hand, that message is not sent to any cell having an unfavorable admission status. In order to keep track of cell admission status, a list data structure is established in memory for each area and may include, for example, an admission indicator for each listed cell. Based on one or more admission criteria, an appropriate value may be stored for each admission indicator in the list. When a message for the mobile station is detected, and the area in which that mobile station is currently registered is determined, a decision is made whether to send that message to one or more cells in the area depending on the admission indicator value for the one or more cells in that area. An alternative cell list structure adds a cell to the list if the condition is met, and removes a cell from the list if the condition is not met. The admission status of each cell is regularly monitored and updated.



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SELECTIVE AND EFFICIENT MESSAGING IN A MOBILE COMMUNICATIONS SYSTEM

FIELD OF THE INVENTION

The present invention relates to wireless communications, and more particularly, to a method and apparatus for selectively and efficiently communicating control messages in a mobile radio network.

BACKGROUND AND SUMMARY OF THE INVENTION

In a typical mobile radio communications system, a geographical area is divided into cell areas served by base stations which are connected to a radio network. Each user (mobile subscriber) in the mobile radio system is provided with a portable radio referred to as a mobile station which communicates one or more types of information, e.g., voice, data, video, etc. with the cellular radio network via one or more radio base stations. Each base station includes a plurality of channel units including a transmitter, a receiver, and a controller and may be equipped with an omni-directional antenna for transmitting equally in all directions in one relatively large cell area or with several directional antennas, each directional antenna serving a particular sector cell. Each mobile station also includes a transmitter, a receiver, a controller, and a user interface and is identified by a specific mobile station identifier. A mobile subscriber is typically identified by another identifier, e.g., an international mobile subscription number (IMSI).

The continuing growth of mobile radio systems fuels the search for ways to improve efficiency. One area where efficiency can be improved relates to control message signaling from a radio network control node to various cells in the network. For example, many paging messages are provided to the mobile communications network and must ultimately be communicated (if possible) to the mobile station via pages transmitted from such cells.

Mobile communications networks are typically divided into paging areas, and each paging area typically contains a number of cells. Paging messages are transmitted to

all paging areas in the service area of the network. Each mobile station informs the network of its current location periodically or whenever it crosses a paging area border by means of a registration access procedure. When the paging area of a mobile station is known, a page message for that mobile station is sent to all the base stations in that particular paging area. Each of those base stations in turn transmit the paging message in each cell associated with that base station. If a page is not answered by the mobile station, the paging process is repeated either within the same paging area or in a larger area.

Thus, when a paging request is received by a radio network control node, there is considerable signaling overhead associated with distributing the paging message to all cells in the paging area. In some cellular systems, that signaling overhead may be carried across the radio interface between base and mobile stations. Once a base station receives a page request, it transmits a paging message over a radio paging channel in each of its associated cells.

The amount of control signaling over the radio interface is an important issue in any mobile communications system; it is particularly important in a Code Division Multiple Access (CDMA) type of mobile communications system. The capacity of a CDMA system is ultimately limited by a maximum interference level in the system which includes both desired and undesired interference signals. If there is a high level of interference, e.g., caused by a large number of mobile stations currently communicating in a cell, that cell is currently "overloaded" from a radio network point of view, and therefore cannot take on additional calls or other requests for radio resources. It is therefore unnecessary to send a page message to an overloaded cell. Even if the mobile station is located in that cell, the call request associated with the page would not be fulfilled because that cell is already overloaded. Accordingly, the problem addressed by the present invention is how to best distribute a page request when one or more cells within the paging area is not granting new call requests for radio resources at current congestion levels.

The present invention solves this problem using a selective messaging procedure that efficiently distributes messages only to eligible cells and eliminates distribution of unnecessary messaging information to ineligible cells. Eligibility is used here

in the broad sense that an eligible cell would be able to productively use or respond to the messaging information while an ineligible cell would not. When information is received in the mobile communications network that is intended for a mobile station located in an area containing one or more cells, the admission status associated with each of the cells in that area is determined. A message associated with the information intended for the mobile station is then sent to one or more of the plural cells whose associated admission status is determined to be favorable. On the other hand, that message is not sent to a cell having an unfavorable admission status.

While the message information may correspond to any type of message, in the example, non-limiting embodiment, the message information relates to a page request for a mobile station. Although the admission status may be determined using any criterion or criteria, in the example embodiment, the admission status is determined using a congestion or overload threshold. A cell with a congestion level at or below the congestion threshold is deemed to have a favorable admission status. A cell having a congestion level above the congestion threshold is deemed to have an unfavorable admission status. The page message may be sent only to those cells in a paging area where the mobile station is registered or otherwise located whose admission status is determined to be favorable. Indeed, if the admission status of the cell in which the mobile station is currently registered is determined to be unfavorable, then the message is not sent to any cell in the area.

In order to keep track of the admission status of the various cells, a list data structure is established in memory for each paging area and may include for each area cell an admission indicator. Based on one or more admission criteria, a value may be stored for each of the admission indicators in the list. When a message for the mobile station is detected, and the area in which that mobile station is currently registered determined, a decision is made whether to send that message to one or more cells in the area depending on the admission indicator value for the one or more cells in that area. The admission status of each cell is regularly monitored and updated in the list.

An alternative cell list structure may be employed. For each paging area, the congestion level for each cell is checked to determine if it exceeds a threshold. A cell is

added to its paging area's list if the threshold is not exceeded. On the other hand, if the threshold is exceeded, that cell is removed from the list. That way when a page is detected for a mobile station, the appropriate paging area is identified, and the paging message is sent only to those cells currently included on that paging area's cell list. The admission status for each cell is regularly monitored and the cell list updated.

The present invention reduces the amount of control signaling in the radio network by not sending messages that are not useful or that cannot be acted upon under the current conditions. This decreases data processing and signaling overhead within the radio network itself. It also decreases data processing and signaling between radio base stations and mobile stations over the radio interface. In other words, if a mobile station currently located in a congested cell is paged over the radio interface by the associated base station, the mobile station will naturally respond with a request for radio resources over the radio interface to support that call in response to the page. The base station then must send another message over the radio interface back to the mobile station denying that request because the cell is currently overloaded. By not transmitting these unnecessary signals over the radio interface, the present invention preserves limited radio resources for more productive requests and also avoids contributing to the already significant congestion problem.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features, and advantages of the invention will be apparent from the following description of preferred example embodiments as well as illustrated in the accompanying drawings in which reference characters refer to the same parts throughout. While individual functional blocks and components are shown in many of the figures, those skilled in the art will appreciate these functions may be performed by individual hardware circuits, by a suitable programmed digital microprocessor, by an application specific integrated circuit (ASIC), and/or by one or more digital signaling processes (DSPs).

Fig. 1 shows a diagram of an example mobile radio communications system in which the present invention may be employed;

Fig. 2 is a simplified function block diagram of a radio network controller and a base station;

Fig. 3 is a simplified function block diagram of a mobile station;

Fig. 4 illustrates example location and registration areas;

Fig. 5 is a flowchart diagram illustrating a selective messaging procedure in accordance with one embodiment of the present invention;

Fig. 6 is a diagram of a conceptual example list data structure for plural paging areas;

Fig. 7 is a selective paging routine in accordance with one example, non-limiting selective paging routine in accordance with one example embodiment of the invention; and

Fig. 8 is another example, non-limiting selective paging routine in accordance with another example embodiment of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

In the following description, for purposes of explanation and not limitation, specific details are set forth, such as particular embodiments, network architectures, signaling flows, protocols, techniques, etc., in order to provide an understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be practiced in other embodiments that depart from these specific details. For example, while the present invention is disclosed in the example context of paging messages and congested cells, those skilled in the art will appreciate the present invention can be applied to any type of message and to any type of admission condition. In other instances, detailed descriptions of well-known methods, interfaces, devices, protocols, and

signaling techniques are omitted so as not to obscure the description of the present invention with unnecessary detail.

The present invention is described in the non-limiting, example context of a universal mobile telecommunications system (UMTS) 10 shown in Fig. 1. A representative, circuit-switched, external core network, shown as a cloud 12 may be for example the public switched telephone network (PSTN) and/or the integrated services digital network (ISDN). Another circuit-switched, external core network may correspond to another Public Land Mobile radio Network (PLMN) 13. A representative, packet-switched, external core network shown as cloud 14 may be for example an IP network such as the Internet. The core networks are coupled to corresponding network service nodes 16. The PSTN/ISDN network 12 and other PLMN network 13 are connected to a circuit-switched core node (CSCN), such as a Mobile Switching Center (MSC), that provides circuit-switched services. In an existing cellular network model, here the Global System for Mobile Communications (GSM), the MSC 18 is connected over an interface A to a base station subsystem (BSS) 22 which in turn is connected to a radio base station 23 over an interface A'. The packet-switched network 14 is connected to a packet-switched core node (PSCN), e.g., a General Packet Radio Service (GPRS) node 20 tailored to provide packet-switched type services in the context of GSM which is sometimes referred to as the Serving GPRS Service Node (SGSN). Each of the core network service nodes 18 and 20 also connects to a UMTS terrestrial radio access network (UTRAN) 24 over a radio access network interface. The UTRAN 24 includes one or more radio network systems (RNS) 25 each with a radio network controller (RNC) 26 coupled to a plurality of base stations (BS) 28 and to the RNCs in the UTRAN 24.

Preferably, radio access over the radio interface is based upon wideband, Code Division Multiple Access (WCDMA) with individual radio channels allocated using CDMA spreading codes. Of course, other access methods may be employed. WCDMA provides wide bandwidth for multimedia services and other high transmission rate demands as well as robust features like diversity handoff and RAKE receivers to ensure high quality communication service in a frequently changing environment. Each mobile

station is assigned its own scrambling code in order for a base station 28 to identify transmissions from that particular mobile station. The mobile station also uses its own scrambling code to identify transmissions from the base station either on a general broadcast or common channel or transmissions specifically intended for that mobile station. That scrambling code distinguishes the scrambled signal from all of the other transmissions and noise present in the same area.

Simplified function block diagrams of the radio network controller 26 and base station 28 are shown in Fig. 2. The radio network controller 26 includes a memory 50 coupled to data processing circuitry 52 that performs numerous radio and data processing operations required to perform its control functions and conduct communications between the RNC 26 and other entities such as the core network service nodes, other RNCs, and base stations. Data processing circuitry may include any one or a combination of a suitably programmed or configured general purpose computer, microprocessor, microcontroller, dedicated logic circuitry, DSP, ASIC, etc. The base station 28 includes a data processing and control unit 54 which, in addition to performing processing operations relating to communications with the RNC 26, performs a number of measurement and control operations associated with the base station radio equipment such as transceivers 56 connected to one or more antennas 58. Mobile station 30, shown in function block format in Fig. 3, includes a data processing control unit 60 for controlling various operations required by the mobile station 30. The mobile station's data processing and control unit 36 provides control signals as well as data to a radio transceiver 62 connected to an antenna 66. Both the data processing and control unit 60 and the transceiver 62 are powered by a battery 64. The amount of power supplied by the battery 64 is regulated by one or more control signals from the data processing and control unit 36.

Different types of control channels are shown bridging the radio interface. For example, in the forward or downlink direction, there are several types of broadcast channels including a general broadcast channel (BCH), a paging channel (PCH), and a forward access channel (FACH) for providing various types of control messages to mobile stations. In the reverse or uplink direction, a random access channel (RACH) is employed

by mobile stations whenever access is desired to perform location registration, call origination, page response, and other types of access operations.

As mentioned above, the UMTS 10 may be divided into a plurality of areas, each area containing a plurality of cells as illustrated in Fig. 4. Each cell is a geographical area where radio coverage is provided by radio base station equipment at a base station site. A base station may serve one or more cells. The particular areas illustrated in Fig. 4 include Location Areas (LA(1)-LA(3)) 32 indicated by cross-hatching and UTRAN Registration Areas (URA(1)-URA(3)) 34. When a mobile station moves into a new location area or registration area, the mobile station updates the network with its current location or registration area. A LA refers to a paging area associated with a core network. A URA refers to a paging area associated with the UTRAN. The LA is applicable when the mobile station is powered on but is in an idle mode. The URA is applicable when the mobile has established a packet data connection but is not currently sending or receiving data. The LA and URA are only non-limiting examples of paging areas. Thereafter, the mobile station may move freely between cells belonging to that same location area or registration area without having to perform a registration update procedure. Consequently, if information is to be sent from the network to the mobile station and the location of the mobile station is known only at a location or registration area level, (rather than at a cell level), a paging message is broadcast in all cells belonging to the location/registration area where the mobile station made its last registration area update.

Notice that location areas 32 and UTRAN registration areas 34 contain cells coupled to more than one base station. As described above, when a paging request is issued from a core network to an RNC 26, the RNC typically identifies the location or registration area where the paged mobile is believed to be currently located, e.g., last registered. The page request is then distributed to all cells in the paging area. Fig. 4 shows two cells in both a location area LA(1) and a UTRAN registration area URA(1) in an overloaded state which will not take on additional call requests. Accordingly, the inventors of the present invention recognized that it is pointless to send paging messages to these overloaded cells, like cells 4 and 5, if additional call resources cannot be allocated to

support another call in those overloaded cells. The paging, the subsequent attempt by the mobile to respond to the page, and the denial of the call all further contribute to the congestion/overloading problem. Instead, a page request in accordance with the invention is only sent to those cells within the paging area that are in a "normal state" as shown in Fig. 4. For example, a page request to a mobile registered in LA(1) would only be sent to and therefore transmitted from cells 1, 2, 3, and 6.

Fig. 5 outlines a selective messaging routine (block 70) in accordance with a first embodiment of the present invention. Initially, information is received for a mobile station located in a cell contained in a particular location area or registration area which typically, although not necessarily, consists of more than one cell (block 72). The current admission status associated with each of the cells in the area is determined before or after the receipt of that information (block 74). Admission status may be based on the congestion level of a particular cell as indicated in Fig. 2 in terms of the cell's ability to allocate new resources to a call. In addition to a new call, there may be an existing call which is currently supported where additional resources are requested for that call, e.g., radio bandwidth resources for a video connection coupled with the existing voice connection. However, admission status may be based on any type of condition or criterion that might be used to control the admission of new calls or the allocation of new resources in the cell. A message associated with the information received for the mobile station (or the information itself) is then sent to one or more cells where the admission status is currently determined to be favorable (block 76). The message may be any sort of message including but not limited to paging messages, measurement-related messages, admission control messages, broadcast parameter messages, short data messages, etc. Conversely, such a message is not sent to any cell where the admission status is currently determined to be unfavorable (block 76).

While the present invention is applicable to any type of message and the admission status is applicable to any type of any type of condition, the subsequent example embodiments of the invention are described, for illustration purposes only, in terms of

paging messages to cells whose admission status is determined by the current congestion level in those cells.

In the example implementation of the invention, the memory 50 in the RNC 26 stores a list for each paging area in the mobile communications network. Of course, the list structures could be stored in some other control node in the network such as the base stations. One example list data structure is shown in Fig. 6. Two exemplary lists are shown for location areas LA(1) and LA(2), each of which contain six cells numbered (1-6). For each cell entry in the list there may be an associated base station identifier and an admission status indicator. For example, if the admission status is favorable, a flag may be set to "1"; otherwise, an unfavorable condition is indicated with a "0". Other more elaborate admission status indication schemes may be employed. As can be seen in the example lists, location area LA(1) includes four cells (1-4) coupled to base station BS(1) and two cells (5-6) coupled to base station BS2. Five cells (1-5) are contained in URA(1) and four cells (6, 1, 2, and 3) are contained in URA(2) with one cell (6) in URA(2), overlapping with one cell in LA(1). Three cells (4, 5, and 6) of URA(3) are also included in location LA(2). Only cells 4 and 5 in location area LA(1) are currently overloaded. The URA entries are optional.

Reference is now made to an example Selected Paging routine (block 80) in accordance with one non-limiting embodiment of the present invention which employs the list structure illustrated in Fig. 6. A list is established for each location area including a cell entry and an admission status indicator (block 82). Other optional entries indicate the current base station and UTRAN registration area (URA) associated with each cell. The congestion level is then determined for each cell. An appropriate admission status indicator, e.g., a flag bit, corresponding to that determined congestion level is stored in the list (block 84). The congestion level may be determined for example by comparing a measured signal-to-interference ratio or other congestion-type parameter.

A page is detected for a mobile station and routed to the RNC (block 86). The RNC processing circuitry 52 determines in which location area the mobile station is currently located or registered (block 88). The processing circuitry accesses memory 50,

and in particular the list corresponding to the determined location area, to determine and select which cells in that location area (if any) have a favorable admission status and therefore should receive a page message (block 90). The corresponding paging message is then sent to the selected cells (block 92). The procedure continues by again detecting the current congestion level in each cell in each location area and updating the admission status in the corresponding location area list in memory 90 (block 94). In the event that the location of the mobile station is known at a cell level, the paging message is sent only to that cell if it is not congested. If the cell is congested, the paging message is not sent at all.

In an alternative example, the list structure employed in memory 50 may simply contain only entries for those cells having a favorable admission status. In other words, cells having an unfavorable admission status are removed from the list while cells having a favorable admission status are either added or maintained in the list. In this regard, reference is now made to the Selective Paging routine (block 100) shown in Fig. 8. A cell list is established for each location area (block 102). For each cell in a location area, the RNC processing circuitry 52 determines whether a congestion level exceeds a threshold (block 104). If the threshold is exceeded, the processing circuitry 52 removes that cell from the list (block 106). If the threshold is not exceeded, the processing circuitry 52 adds that cell to the list (block 108). When a page is detected for a mobile station by the RNC (block 110), it determines the location area when the mobile station is currently located or otherwise registered (block 112). The processing circuitry 52 then checks the corresponding location area list in memory 50 and sends a paging message only to those cells currently included in that area's cell list (block 114). Thereafter, as in the routine in Fig. 7, the processing circuitry 52 continues to determine the congestion level in each cell and updates the cell list for each location area (block 116).

The present invention provides a number of benefits. First, the amount of control signaling in the radio network is reduced because messages that are not useful or that cannot be acted upon under current conditions are not sent. This decreases data processing and signaling overhead within the radio network itself. It also decreases data processing and signaling between radio base stations and mobile stations over the radio

interface. For example, if a mobile station currently located in a congested cell is paged over the radio interface by an associated base station, the mobile station will naturally respond with a request for radio resources over the radio interface to support the call in response to the page. The base station then sends another message over the radio interface back to the mobile station denying the request because the cell is currently overloaded. By not transmitting the page from the radio network to the congested cell in the first place, the interference level in that cell is reduced or at least not increased in the downlink direction. In addition, because the mobile station does not respond to the page, interference is also reduced in the uplink direction. Moreover, there is at least an attempt to reach the mobile station in non-congested cells in the paging area.

While the present invention has been described in terms of a particular embodiment, those skilled in the art will recognize that the present invention is not limited to the specific example embodiments described and illustrated herein. Different formats, embodiments, and adaptations besides those shown and described as well as many modifications, variations, and equivalent arrangements may also be used to implement the invention. Accordingly, it is intended that the invention be limited only by the scope of the claims appended hereto.

WHAT IS CLAIMED IS:

1. In a mobile radio communications system including plural base stations coupled to a controller and communicating over a radio interface with mobile stations, where each base station is associated with plural cells, a method comprising:

receiving information intended for a mobile station located in one of the plural cells;

determining an admission status associated with each of the plural cells; and

sending a message associated with the information intended for the mobile station to one or more of the plural cells when the admission status associated therewith is determined to be favorable;

wherein the message associated with the information intended for the mobile station is not sent to one or more of the plural cells where the admission status is determined to be unfavorable.

2. The method in claim 1, wherein the message information intended for a mobile station is a control message.

3. The method in claim 1, wherein the admission status is based on a congestion threshold so that a cell having a congestion level at or below the congestion threshold has a favorable admission status and a cell having a congestion level above the congestion threshold has an unfavorable admission status.

4. The method in claim 1, wherein the first cell is a member of a first group of cells assigned to a first area, and wherein the message associated with the information intended for the mobile station is not sent if the admission status in the first cell is determined to be unfavorable.

5. The method in claim 1, wherein the first cell is a member of a first group of cells assigned to a first area, and wherein the message associated with the information intended for the mobile station is sent only to those cells in the first area whose the admission status is determined to be favorable.

6. The method in claim 1, further comprising:

generating a list corresponding to the plural cells;

storing in the list an indicator of the determined admission status associated with each of the plural cells; and

sending the message associated with the information intended for the mobile station only to cells in the list whose associated admission status indicator is favorable.

7. The method in claim 1, further comprising:

generating a list corresponding to the plural cells;

monitoring the admission status of each of the plural cells included in the list; and

removing one or more cells from the list whose admission status is unfavorable.

8. The method of claim 7, further comprising:

adding one or more cells to the list whose admission status is favorable.

9. A method for selectively sending a message to a mobile station in a mobile communications network having established plural areas, each area including one or more cells, comprising:

establishing a list for each area containing an admission indicator for each cell included in that area;

providing a value for each of the admission indicators in the list;

detecting a message for the mobile station;

determining the area with which the mobile station is currently associated; and

determining whether to send the message to one or more cells in the area depending on the admission indicator value for the one or more cells in the area.

10. The method in claim 9, wherein the admission indicator relates to a congestion level of the associated cell.

11. The method in claim 9, wherein the admission indicator relates to an availability of communication resources in the associated cell.

12. The method in claim 9, wherein the associated area is where the mobile station is either currently registered or located.

13. The method in claim 12, wherein the area includes plural cells associated with one base station.

14. The method in claim 12, wherein the area includes cells associated with more than one base station.

15. The method in claim 9, wherein the message is a page.

16. The method in claim 9, wherein when the admission indicator value for a cell in the area is unfavorable, the message is not sent to that cell.

17. A method for selectively sending a message to a mobile station in a mobile communications network having established plural areas, each area including one or more cells, comprising:

establishing a cell list for at least one area;

adding a cell to the cell list when a congestion status of the cell is equal to or below a threshold;

removing a cell from the cell list when a congestion status of the cell exceeds a threshold; and

sending a message only to those cells currently in the list.

18. The method in claim 17, further comprising:

detecting a message for the mobile station, and

determining the area in which the mobile station is currently registered,

wherein the message is sent only to those cells currently in the list corresponding to the area.

19. The method in claim 17, further comprising:

regularly checking the congestion status of each cell in the area to add and remove cells from the list.

20. The method in claim 19, wherein the congestion status is determined based on a threshold.

21. The method in claim 20, wherein the threshold is variable.

22. The method in claim 19, wherein the message is a paging message.

23. The method in claim 17, further comprising establishing a cell list for each of the plural areas, and for each area's cell list:

adding a cell to each cell list when a congestion status of the cell is equal to or below a threshold, and

removing a cell from each cell list when a congestion status of the cell exceeds a threshold.

24. In a mobile communications system including plural base stations coupled to a controller and communicating over a radio interface with mobile

stations, where each base station is associated with a one or more cells, a control node comprising:

a memory storing a list of one or more cells in an area with an indication for each of the one or more cells of an admission state associated with each of the plural cells; and

data processing circuitry coupled to the memory and configured to store an admission status indicator in the memory for each cell in the list and to determine whether a message intended for a mobile station currently registered at one of the one or more cells should be transmitted to each cell in the list.

25. The control node in claim 24, wherein the admission status indicator corresponds to a congestion level.

26. The control node in claim 24, wherein the electronic processing circuitry determines that the message intended for a mobile station currently registered at one of the one or more cells should be transmitted to each cell in the list that has a corresponding favorable admission status indicator and should not be transmitted to each cell in the list that has a corresponding unfavorable admission status indicator.

27. In a mobile communications system having plural areas and plural base stations coupled to a controller and communicating over a radio interface with mobile stations, where each of the plural areas is associated with a one or more cells, a control node comprising:

a memory storing a cell list for at least one area;

processing means, coupled to the memory, for adding a cell to the cell list when a congestion status of the cell is equal to or below a threshold and removing a cell from the cell list when a congestion status of the cell is exceeds a threshold;

wherein the processing means instructs a message intended for the mobile station to be sent only to those cells currently in the list.

28. The control node in claim 27, the processing means further detecting a message for the mobile station and determining the area in which the mobile station is currently registered,

wherein the message is sent only to those cells currently in the list corresponding to the area.

29. The control node in claim 27, the processing means further regularly checking the congestion status of each cell in the area to add and remove cells from the list.

Fig. 1

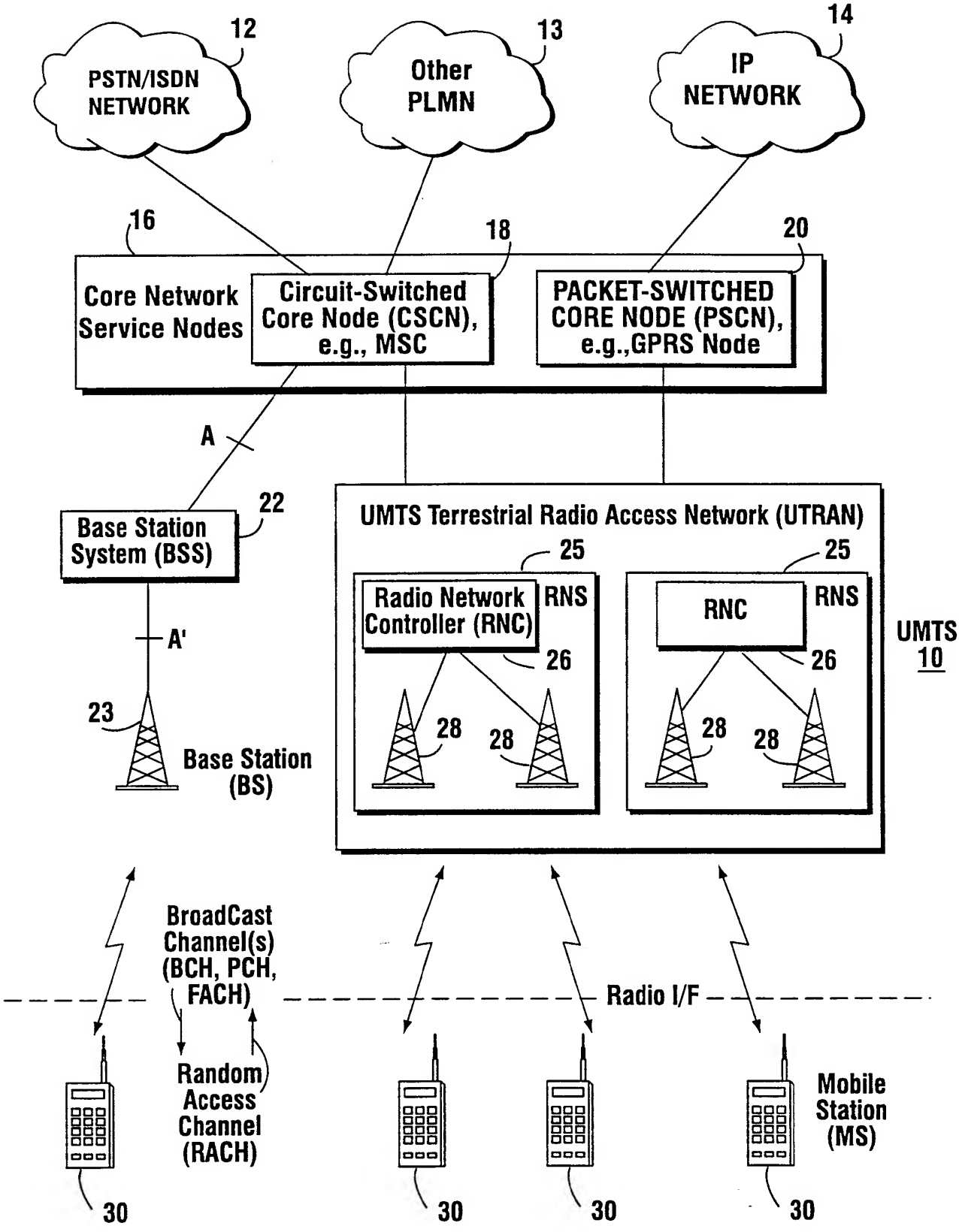

12
PSTN/ISDN NETWORK
13
Other PLMN
14
IP NETWORK
16
Core Network Service Nodes
18
Circuit-Switched Core Node (CSCN), e.g., MSC
20
PACKET-SWITCHED CORE NODE (PSCN), e.g.,GPRS Node
A
22
Base Station System (BSS)
A'
23
Base Station (BS)
UMTS Terrestrial Radio Access Network (UTRAN)
25
Radio Network Controller (RNC)
RNS
26
28
25
RNC
RNS
26
28
UMTS 10
BroadCast Channel(s) (BCH, PCH, FACH)
Radio I/F
Random Access Channel (RACH)
Mobile Station (MS)
30
30
30
30

Fig. 2

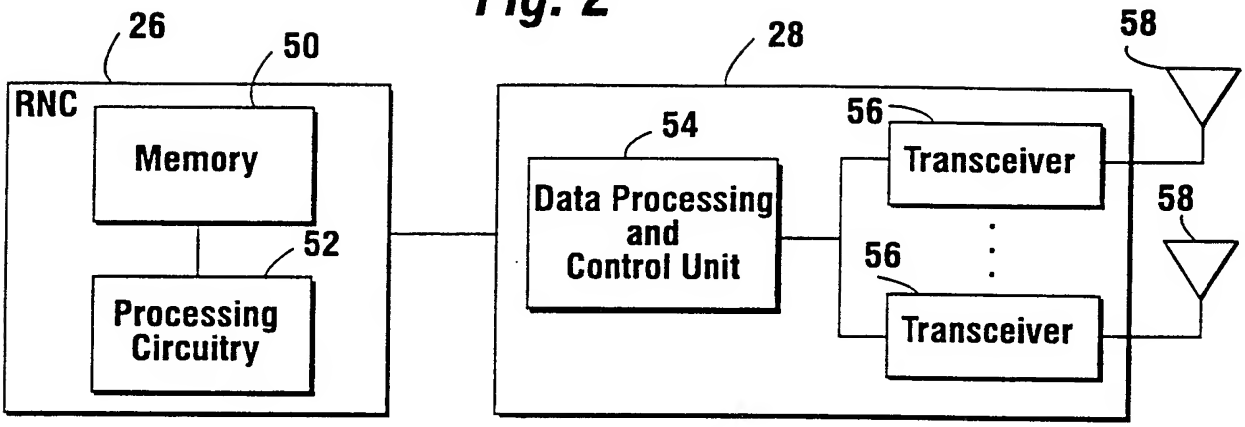
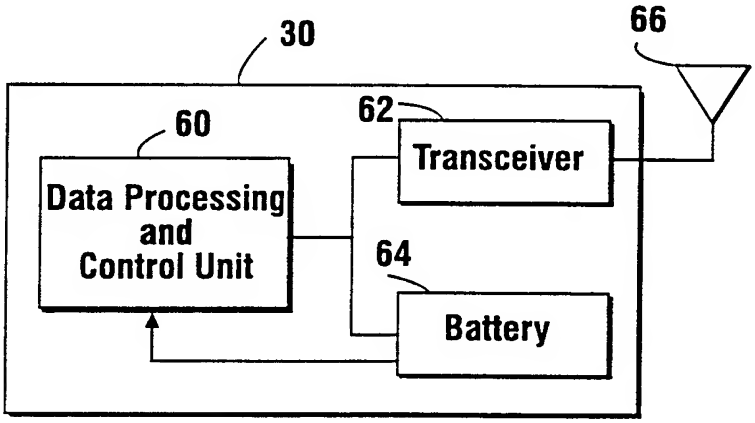


Fig. 3



50

Memory

List For Area LA(1)			
Cell	BS	URA	Admission Status
1	1	1	Favorable
2	1	1	Favorable
3	1	1	Favorable
4	1	1	Unfavorable
5	2	1	Unfavorable
6	2	2	Favorable

List For Area LA(2)			
Cell	BS	URA	Admission Status
1	2	2	Favorable
2	2	2	Favorable
3	2	2	Favorable
4	3	3	Favorable
5	3	3	Favorable
6	3	3	Favorable

Fig. 6

Fig. 4

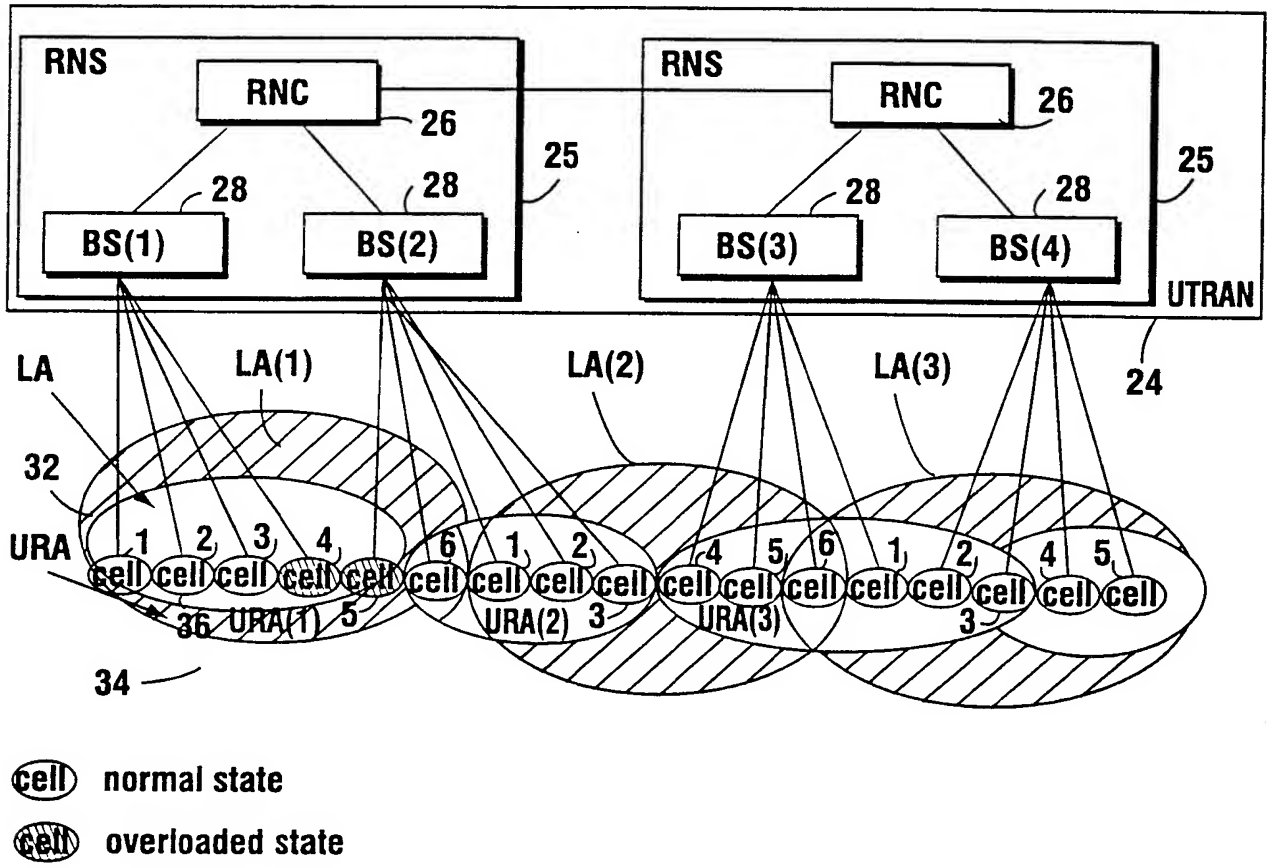

RNS
RNC
26
25
28
28
BS(1)
BS(2)
RNS
RNC
26
25
28
28
BS(3)
BS(4)
UTRAN
24
LA
LA(1)
LA(2)
LA(3)
32
URA
cell
URA(1)
URA(2)
URA(3)
36
34
cell normal state
cell overloaded state

Fig. 5

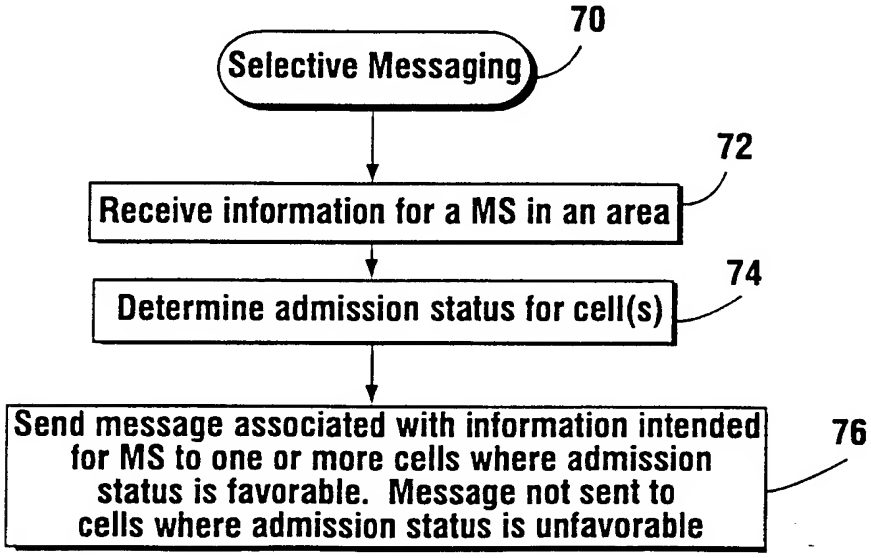

70
Selective Messaging
72
Receive information for a MS in an area
74
Determine admission status for cell(s)
Send message associated with information intended for MS to one or more cells where admission status is favorable. Message not sent to cells where admission status is unfavorable
76

Fig. 7

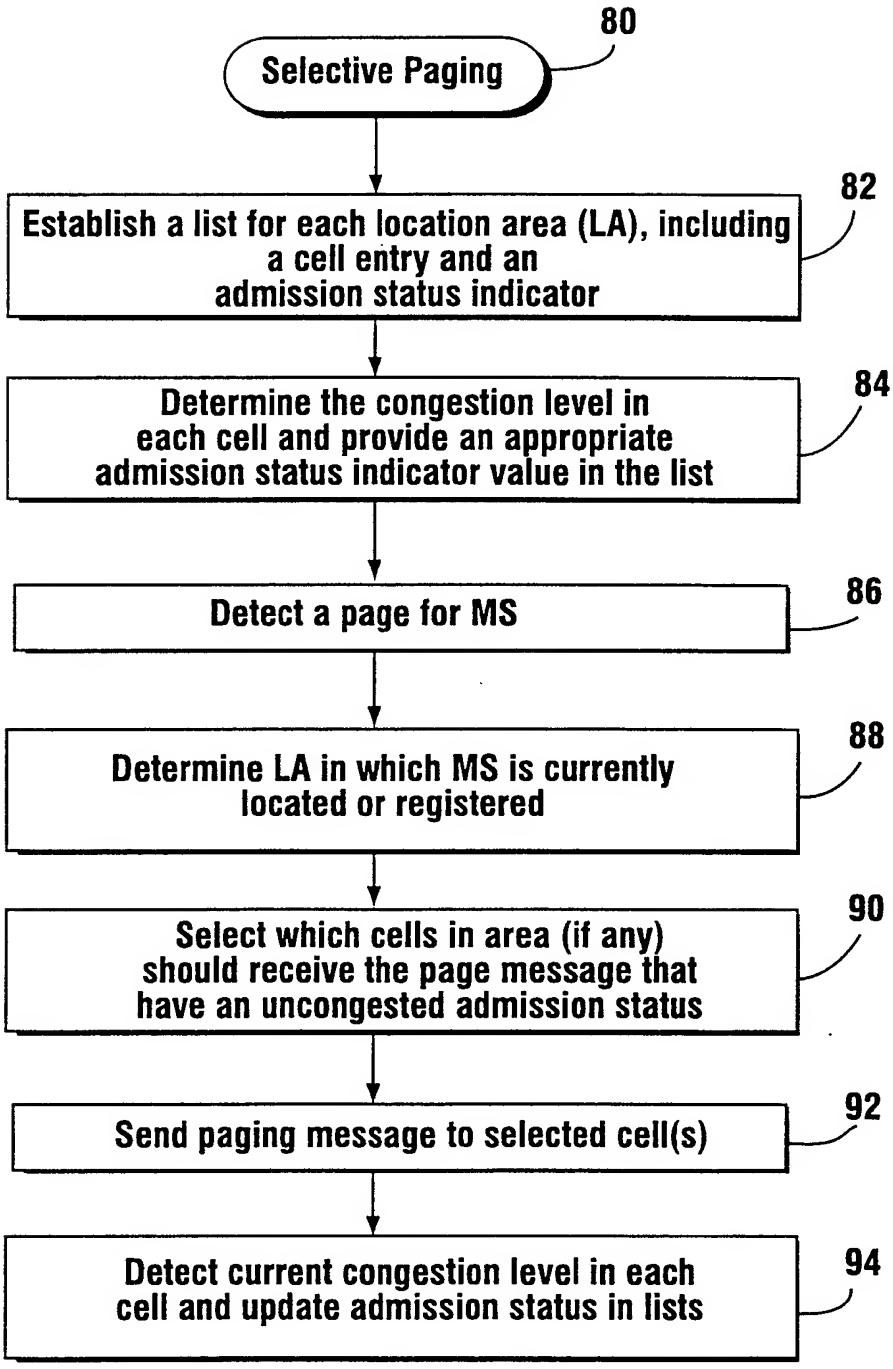
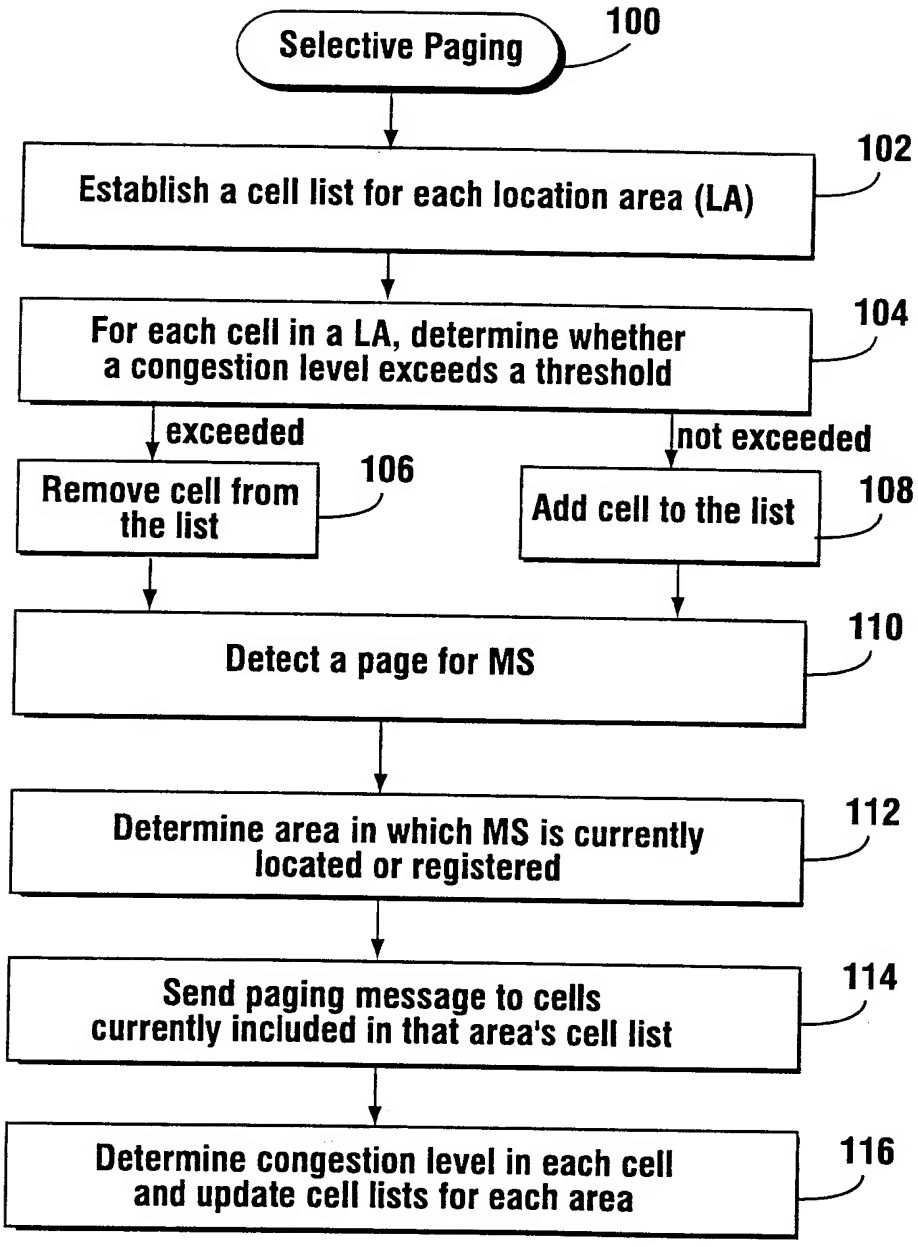

80
Selective Paging
82
Establish a list for each location area (LA), including a cell entry and an admission status indicator
84
Determine the congestion level in each cell and provide an appropriate admission status indicator value in the list
86
Detect a page for MS
88
Determine LA in which MS is currently located or registered
90
Select which cells in area (if any) should receive the page message that have an uncongested admission status
92
Send paging message to selected cell(s)
94
Detect current congestion level in each cell and update admission status in lists

Fig. 8


Selective Paging
100
Establish a cell list for each location area (LA)
102
For each cell in a LA, determine whether a congestion level exceeds a threshold
104
exceeded
not exceeded
Remove cell from the list
106
Add cell to the list
108
Detect a page for MS
110
Determine area in which MS is currently located or registered
112
Send paging message to cells currently included in that area's cell list
114
Determine congestion level in each cell and update cell lists for each area
116

INTERNATIONAL SEARCH REPORT

In. ational application No.
PCT/SE 99/02357

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/22, H04Q 7/38
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9323964 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 25 November 1993 (25.11.93), page 6 - page 9, abstract --	1-27
X	WO 9835520 A2 (NOKIA TELECOMMUNICATIONS OY), 13 August 1998 (13.08.98), page 4 - page 5, abstract --	1-27
X	WO 9836603 A2 (TELEFONAKTIEBOLAGET LM ERICSSON), 20 August 1998 (20.08.98), page 6 - page 9, abstract --	1-27

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 April 2000	24 05. 2000

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/02357

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5649289 A (ZHONGHE WANG ET AL), 15 July 1997 (15.07.97) --	1-27
A	US 5613199 A (MASAHIKO YAHAGI), 18 March 1997 (18.03.97) --	1-27
A	US 5369681 A (ALAIN BOUDREAU ET AL), 29 November 1994 (29.11.94) -- --------	1-27

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Information on patent family members

02/12/99

International application No.
PCT/SE 99/02357

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Information on patent family members

02/12/99

I .ational application No.
PCT/SE 99/02357

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